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Open File Report 89-40

INDUSTRIAL MINERAL PRODUCTION AND CONSUMPTION IN NEW BRUNSWICK

VOLUME 5

DIRECTORY OF NEW BRUNSWICK INDUSTRIAL MINERALS PRODUCERS

by

ADI Limited
Fredericton, New Brunswick

Canada-New Brunswick Mineral Development Agreement
Entente Canada-Nouveau-Brunswick L'Exploitation Minérale

Natural Resources and Energy New Brunswick
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Hon. Morris Green, Minister

1989

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IN NEW BRUNSWICK

VOLUME 5

DIRECTORY OF NEW BRUNSWICK

INDUSTRIAL MINERALS PRODUCERS

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PREFACE

From 1985-1989, the Province of New Brunswick, in conjunction with the Government of Canada, has initiated a number of mineral commodity studies through the Economic Development Program established under a Federal-Provincial Mineral Development Agreement. An important part of this agreement has involved studies designed in part to provide important marketing information on selected industrial minerals. These market-related projects have tended to concentrate on potential market growth areas primarily in North America, and particularly in areas where a New Brunswick producer could be competitive.

Whether it be building stone from Shediac, gypsum from Hillsborough or limestone from Saint John, industrial minerals have historically been important contributors to the economic growth and prosperity of New Brunswick. Today, industrial minerals are still important. Potash mining generates millions of dollars of salaries and business in the Sussex area, while the processing of phosphate rock with by-product sulphuric acid from a nearby lead smelter is a major industry in the Belledune-Bathurst region.

Preliminary figures for the value of industrial mineral production in New Brunswick was about $251 000 000 (Cdn) in 1988 compared to $197 000 000 in 1987. This represents an increase of twenty-two (22) percent. In 1988, industrial mineral production accounted for 31 percent of the total value of Provincial mineral production.

The manufacturing sector of the Province and surrounding areas consume substantial quantities of industrial minerals and their derived chemicals. Changing technology is making new demands on both the quality and quantities of industrial minerals consumed in the region. The requirement to document industrial mineral production in the Province as well as the consumption of these mineral commodities both, in the Province and adjacent areas, is becoming an increasingly important facet of responsible resource management.

Keenly aware of the importance of industrial minerals, the New Brunswick Department of Natural Resources and Energy has sponsored a review of industrial mineral supply and demand for New Brunswick (exclusive of granular and bedrock aggregate). The review was conducted under contract by ADI Limited and Three-D Geoconsultants Limited.

The purpose of the study is to provide as comprehensive and contemporary information as possible concerning the state of the industrial minerals industry in New Brunswick from both a producer's and consumer's point of view. Towards the achievement

of this goal, an assessment of the current supply/demand situation in the Province and adjacent reasonably accessible market areas was undertaken in an attempt to identify potential opportunities for market expansion and future development of indigenous industrial mineral resources. Another study objective is to indicate to various manufacturing industries where sources of various industrial mineral products are located in New Brunswick. Such an approach may be of some value in attracting new manufacturing industries to the Province. In addition, an attempt has been made to identify and document local market opportunties by showing producers where, in what quantities and under what circumstances industrial minerals and industrial mineral-based chemicals are being utilized within the Province and immediate surrounding areas.

Although this study focused primarily on the supply and demand of industrial minerals and industrial mineral-based chemicals produced and consumed in New Brunswick, the demand for similar products in market areas considered reasonably accessible to a local producer were also evaluated to some extent.

The results of the review were issued in the spring of 1989 and consist of a six volume report. Volume 1, 2 and 3 detail the history of specific industrial mineral production and consumption in New Brunswick and current demand within a market place easily accessible from the Province. Volume 4 provides demand projections for key industrial minerals, and describes the possible effects on future demand from environmental, technical, and other developments. Finally, Volumes 5 and 6 include a directory of New Brunswick's industrial mineral producers and consumers of industrial minerals within economic shipping distance of New Brunswick.

Component volumes of this extensive study are listed below:

Volume	Title	Open File Report
1.	Industrial Minerals Used Primarily in the Fertilizer Industry	89-36
2.	Industrial Minerals Used Primarily in the Construction Industry	89-37
3.	Industrial Minerals Used Primarily in the Chemical and Pulp and Paper Industries	89-38
4.	The Future of Industrial Minerals: General Trends in Consumption and Transportation	89-39
5.	Directory of New Brunswick Industrial Mineral Producers	89-40

Volume	Title	Open File Report
6.	Directory of Consumers of Industrial Minerals in Eastern Canada and the Northeastern United States	89-41

This volume presents a directory of industrial mineral producers operating in New Brunswick.

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NEW BRUNSWICK INDUSTRIAL MINERAL PRODUCERS

No.	Name	Location	Producer of
1.	Avon Aggregates Ltd.	Minto	expanded shale (lightweight aggregate)
2.	Brookville Manufacturing Co.	Saint John	dolomitic limestone
3.	Brunswick Mining and Smelting Corp. Ltd.	Belledune	sulphuric acid, diammonium phosphate
4.	Chaleur Silica Limited	Petit Rocher	silica (lump and sand)
5.	CIL Inc.	Dalhousie	chlorine, caustic soda (sodium hydroxide), hydrochloric acid, sodium hypochlorate
6.	Denison-Potacan Potash Company	Sussex	potash
7.	Dupuis Cut Stone Ltd.	Shediac	finished stone products
8.	Elmtree Resources Ltd.	Bathurst	limestone
9.	Havelock Lime	Havelock	agricultural lime, quicklime, hydrated lime
10.	Irving Oil Limited (Refining Div.)	Saint John	sulphur (elemental)
11.	Lafarge Canada Inc.	Havelock	limestone (gypsum), (cement)
12.	L.E. Shaw Limited	Chipman	clay/brick shale
13.	Nelson Monuments Ltd.	Sussex	quarried granite, monumental stone, curb stone, finished stone products
14.	Potash Company of America (a Division of Rio Algom Limited)	Sussex	potash, salt
15.	St. Anne Chemical Company Ltd.	Nackawic	chlorine, caustic soda (sodium hydroxide), sodium chlorate, hydrochloric acid
16.	Smith Cut Stone and Quarries Limited	Shediac	red sandstone, olive green sandstone, finished stone products
17.	Sussex Silica Inc.	Sussex	silica (lump and sand)
18.	Upper Kent Lime Works Ltd.	Bath	limestone (marl)

NEW BRUNSWICK PRODUCERS
(INDUSTRIAL MINERALS)

1. AVON AGGREGATES LTD.

Producer of: Expanded Shale (lightweight aggregate)

Name:	Avon Aggregates Ltd.
Address:	P. O. Box 5000 275 Salisbury Road Moncton, Westmorland Co. E1C 8R2
Telephone:	853-8853
Contact Person:	R. J. McNeil
Plant Location:	Minto, N. B. 327-6122
Established:	1971
No. of Employees:	1-9
Ownership:	Modern Enterprises Ltd.
History:	The operation started in 1971 and has operated on an as-required basis since then.
Raw Material:	A porous shale is used as the source of raw material. The shale overlies the coal seam in the area. At the actual mining location the coal seam was removed by underground mining in the 1930s.
Mining/Processing Methods:	The raw material is excavated and crushed, then fed into a 40 foot rotary kiln. The kiln is coal-fired and operates at a temperature of about 2000°F. Thermal decomposition of the shale releases various gases including CO_2 and water and causes a rapid expansion (popping) to produce lightweight aggregate. The material is then crushed and screened to the required size fractions.
Products and Capacity:	The aggregate material produced has about 60 percent of the weight of conventional materials but has high hardness and abrasion characteristics. The selling price is in the order of $50 per ton FOB the Minto plant. Market demand is currently

Producer of: Expanded Shale (lightweight aggregate)

met with about 45 days of operation per year. Stockpiles are used to fill orders as required (during the operation period, a 24 hr per day production is maintained due to the energy costs and time required to bring the kiln to operating temperature).

The material is marketed in the Maritimes and Quebec and is used in the manufacture of concrete wall panels, bricks, concrete blocks and similar products. The light weight for building panels reduces the structural steel requirements for building construction. The material has good potential for use in marine construction such as offshore oil projects and the proposed fixed link crossing to PEI.

Remarks:

Markets in the US have declined due to the opening of a similar operation in New York State.

High energy costs for the kiln and high transportation costs are limiting factors in market expansion. Increased acceptance by architects and designers could result in a market expansion. Examples of projects which have used the material include the King's Place shopping/office complex and parking garage in Fredericton, the Harbour Bridge in Saint John and various buildings in Moncton and other centres.

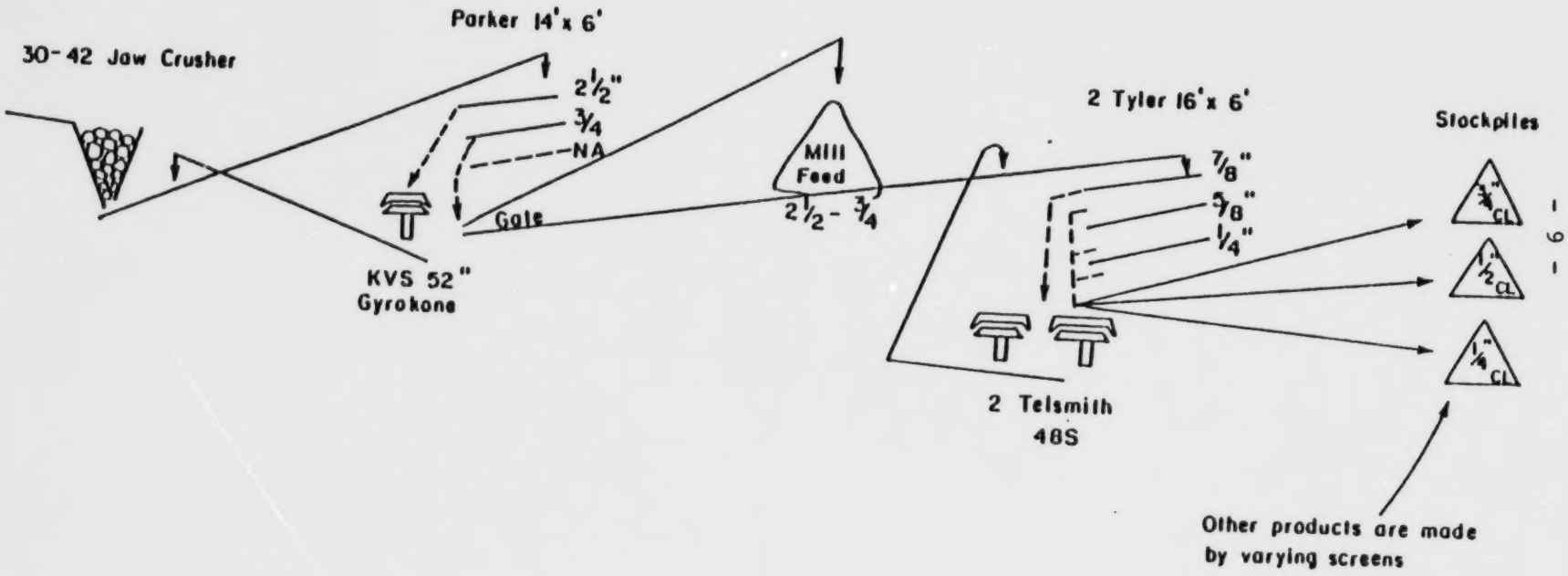
2. BROOKVILLE MANUFACTURING CO.

Producer of: Dolomitic Limestone

Name:	Brookville Manufacturing Co.
Address:	Box 2332, Station C Saint John, N.B. E2L 3V6
Telephone:	633-1200
Contact Person:	Michael Sanford, General Manager
Established:	1921
No. of Employees:	16-45
Ownership:	A division of Moosehead Breweries Ltd.
History:	The quarry, originally known as the Lawlor quarry, has been in operation for over 70 years. The operation was acquired by the Moosehead interests in 1972 and initially operated as a subsidiary, eventually becoming a division of the brewery group of companies.
Raw Material:	The operating quarry extracts a dolomitic rock (40 to 45% Mg CO_3) of Precambrian age. High calcium deposits are also available but are not currently operated.
Mining/Processing Methods:	The rock is extracted using drill and blast techniques. Downhole hammers are used to drill 2½ inch holes. The rock is trucked from the pit about 800 m to the plant, using Barford trucks. Primary crushing is accomplished using a 30-42 jaw crusher and is screened on a Parker triple deck screen system (14 x 6 feet). Oversized material is routed to a 52 inch KVS Gyrokone crusher. Mill feed is 2½ to 3/4 inch material. Crushing capacity is 250 tonnes per hour (see Figure 1). Aggregate material is further sized on two triple deck Tyler screens (16 x 6 feet) with oversize material crushed on two Telsmith 48S crushers. Various aggregate sizes are produced by varying screen sizes.

FIGURE 1

BROOKVILLE
AGGREGATE PLANT



Producer of: Dolomitic Limestone

The milling (pulverizing) capacity is 90 tonnes per hour. The 2½ to 3/4 mill feed material passes through a hammer mill and various screening circuits and roll mills to produce agricultural lime and related products.

Products and Capacity:

About 140,000 tonnes per year of aggregate products are sold annually to local markets. Granular aggregate for roofing materials is a component of this market.

Agricultural lime is produced at a rate of about 90,000 tonnes per year. The material typically is 56% passing 100 mesh (150 microns) with nothing larger than No. 10 (2 mm) sieve size. A superfine product (50% passing 230 mesh or 63 microns) is also produced and is used by peat (soil mix) producers as well as the retail market.

Fertilizer filler is also produced at a rate of 10,000 to 15,000 tonnes per year. The material is 1.4 mm and less (pass 14 mesh) and is treated with calcium chloride to minimize dust problems.

About 10% of the dolomitic lime products are sold in bags with the remainder shipped in bulk. Bagged material costs $30 to $35 per tonne (FOB plant) whereas bulk material is in the order of $14 per tonne.

Over 95% of the product is shipped by truck. Rail is regarded as efficient in long haul situations (50 tonne cars) but use is expected to decline with the closure of the railway in Prince Edward Island. The operation is equipped with van loading facilities for supertherm vans supplied by the railways.

Major markets areas are New Brunswick, Prince Edward Island and Maine.

Producer of: Dolomitic Limestone

Remarks: The mineral rights to the quarry are held under an original Kings Land Grant.

3. BRUNSWICK MINING AND SMELTING CORP. LTD.

Producer of: Sulphuric Acid, Diammonium Phosphate

Name:	Brunswick Mining and Smelting Corp. Ltd. (Smelting and Fertilizer Division)
Address:	Belledune, Gloucester Co., N.B. E0B 1G0
Telephone: **Telex:** **Fax:**	522-2100 014-24583 522-2807
Contact Person:	Bruce Neill (smelter) Tom Gravestock (fertilizer)
Established:	1966
No. of Employees:	Smelter: 600 Fertilizer: 100
History:	The smelter was established in 1966 to process ore from the mining operation located south of Bathurst. The fertilizer plant (formerly known as Belledune Fertilizer) was established in 1968.
Raw Material:	Lead concentrate is delivered to the smelter by train from the mining operation about 50 km to the south.
Mining/Processing Methods:	The smelting of the lead concentrate produces sulphur dioxide gas (SO_2). An electrostatic precipitator removes particulate matter and the gas is cooled and dried in the acid plant to produce sulphuric acid (H_2SO_4) at about 99% purity. The acid is diluted to about 94% and transported to the fertilizer plant. The fertilizer plant imports about 270,000 tonnes per year of phosphate rock from Florida. The rock (or more correctly, beneficiated ore) arrives by sea and typically is in small pellets (½ inch diameter or less). The rock is reacted with the sulphuric acid to produce phosphoric acid (H_3PO_4) as an intermediate process step. The phosphoric acid is then reacted with ammonia (NH_3) to produce diammonium phosphate (DAP).

Producer of: Sulphuric Acid, Diammonium Phosphate

About 37,000 tonnes per year of ammonia arrives by tank car from the CIL Cynamid plant in Ontario.

In 1986 the fertilizer plant made a conversion from the dihydrate process to the hemihydrate process. The hemihydrate process, under license from Norsk-Hydro Fertilizer, results in substantial energy savings. The pilot conversion was designed by Societe de Prayon and built by Wellman Power Gas Inc. at a cost of about 4 million.

Product and Capacity:

Approximately 180,000 tonnes per year of sulphuric acid are produced by the smelter. Statistics Canada (1987) reports this production as 91,000 tonnes of sulphur in smelter gas with a value of $11.4 million, i.e., about $120/tonne. However, the going rate on the open market is $US 15-40 per tonne f.o.b. the producer and the estimated value landed at Belledune is $60 US/tonne.

The rate of production of diammonium phosphate at the fertilizer plant is primarily a function of the level of sulphuric acid production at the smelter. At present about 20,000 tonnes per year of sulphuric acid is brought in from the Beloeil plant near Montreal to maintain production levels. However, the plant operates on a 3 shift per day, 5 day week basis for 9 months each year and thus is operating at about 55% of capacity.

Annual production of diammonium phosphate is about 150,000 tonnes per year. Only a single product type is produced. Monoammonium phosphate (MAP) has also been produced in the past but market demand did not warrant continuation and none has been produced since the plant conversion. Phosphoric acid is produced at an intermediate stage of the process but is at a 40-42%

Producer of: Sulphuric Acid, Diammonium Phosphate

purity. Commercial grade is about 56%. The high purity is not required in the existing process and market demand does not warrant the additional processing necessary to produce high purity acid.

Over 80% of the sales of diammonium phosphate is to the domestic fertilizer market. Shipments are mainly by truck and rail to the Maritimes, eastern Quebec and Maine. Small quantities are shipped by sea.

Remarks:

One of the by-products of the phosphate production is a phosphogypsum. For every tonne of phosphoric acid approximately three tonnes of phosphogypsum are produced. This material is currently discharged in an environmentally acceptable manner into the sea. The company has investigated several alternatives for utilization of this material including use in the sintering process in the smelter (limestone is currently used) and in wallboard manufacturing. However, impurities present in the phosphate rock (which are further concentrated by the processing) detract from the quality and limit the marketability of this material.

4. CHALEUR SILICA LIMITED

Producer of: Silica (Lump and Sand)

Name:	Chaleur Silica Limited
Address:	c/o Elmtree Resources Ltd. P.O. Box 665 Bathurst, N.B. E2A 3Z6
Telephone:	(506) 546-6382
Contact Person:	Al Buzas
Established:	1974
No. of Employees:	N/A
Ownership:	Elmtree Resources Ltd.
History:	The deposit was evaluated in 1961 as a source of silica for the smelter at Belledune. A small quarry was opened in 1974 and was acquired by the present operators in 1976 to supply flux to the smelter. A bagging plant was installed in 1979 to package blasting sand, etc. In 1988 the operation was sold to Elmtree Resources Ltd. who intend to maintain production pending market demand.
Raw Material:	Sandstone is extracted from a quarry located at Bass River, 7 km east of Bathurst.
Mining/Processing Methods:	Hydraulic hammers have been used to extract the rock from the quarry. Blasting was initially used; such an extraction method was stopped because of the proximity of dwellings. The material was trucked to a plant at Petit Rocher where it was crushed and screened into various size fractions. Inside storage was used to keep the material dry and prevent frozen lumps in winter shipments. Material for blasting sand and similar products was washed and dried. The product was sold in bulk or packaged in 36.3 kg (80 lb) bags.

Producer of: Silica (Lump and Sand)

Nursery sand (silica grit) was used by tree nurseries as a "top dressing" in finger pots to minimize fungal development, etc. The market in New Brunswick was relatively small but considerable quantities were shipped to Quebec, including the Joliette and Abitibi regions.

A coarse material (about 1 inch) was also produced and marketed to Lafarge Canada Inc. in Havelock, N.B. Quantities of 5 to 10,000 tonnes per year were consumed in the production of specialty cement but the closure of the Lafarge operation in 1983-84 curtailed this market.

Small quantities of sand were also sold for various uses including manufacture of epoxy-based flooring products.

Products and Capacity:

Although the operation was capable of producing 150,000 tonnes per year, annual output was typically in the order of 40,000 to 60,000 tonnes per year. Flux sand for the smelter at Belledune traditionally accounted for about 95 percent of the quantities produced.

Silica flux accounts for over 10 percent of the smelter feed. The specifications for this material is not stringent (over 90 percent SiO_2) but consistency is important. A dry, granular product is important to minimize operational problems with screens and conveyors at this smelter. The product readily met these requirements (i.e., routinely in the 95 percent SiO_2 range).

Other products comprised about 5 percent of the quantity produced but were higher value products, accounting for up to 50 percent of the total value of production. These products included blasting sand and

Producer of: Silica (Lump and Sand)

silica grit for tree nurseries. These products were typically washed and dried and sold in bulk or bags. A 98 to 99 percent SiO_2 content was typical in these products.

Five grades of blasting sand were produced:

No. 10A 6-12 mesh (US Standard Sieve)
No. 10B 6-10 mesh
No. 2 10-16 mesh
No. 1 16-24 mesh
No. 0 24-40 mesh
No. 00 minus 40 mesh

Remarks:

The mineral rights to the quarry are held by A. Ronalds and G. Ronalds under an original King's Grant.

5. CIL INC.

Producer of: Chlorine, Caustic Soda (Sodium Hydroxide), Hydrochloric Acid, Sodium Hypochlorate

Name:	CIL Inc.
Address:	Box 850 Dalhousie, N.B. E0K 1B0
Telephone:	684-2475
Contact Person:	Robert Lanteigne
Established:	1963
No. of Employees:	52-56
Ownership:	CIL Inc.
History:	Established to supply the pulp and paper industry in northern New Brunswick.
Raw Material:	The current source for salt is The Canadian Salt Co. in Pugwash, N.S.
Mining/Processing Methods:	The plant uses a mercury cell process. A salt brine solution is electrolyzed to disassociate the chloride and sodium ions. Mercury acts as a cathode and collects the sodium ions to form sodium hydroxide, when in contact with water. The chloride ions are discharged at the anode which liberates chlorine gas. The gas is then liquified. Some of the gas is also used to produce hydrochloric acid by a synthesis process with hydrogen. Waste gas is absorbed to form sodium hypochlorate.
Products and Capacity:	Approximately 30,000 tonnes of chlorine and 33,000 tonnes of caustic soda (sodium hydroxide) are produced annually (total capacity is 71,000 short tons). These products are sold in a liquid form and are transported by rail tank car. The primary market is the pulp and paper industry including operations in Atholville, Dalhousie, Bathurst, the Miramichi and occassionally in southern New Brunswick.

Producer of: Chlorine, Caustic Soda (Sodium Hydroxide), Hydrochloric Acid, Sodium Hypochlorate

Production of hydrochloric acid is in the order of 5 to 10,000 tonnes per year depending on market demand. Hypochlorate is essentially a by-product produced at levels of 2-5000 tonnes per year. Supply frequently exceeds demand for this commodity.

6. DENISON-POTACAN POTASH COMPANY

Producer of: Potash

Name:	Denison-Potacan Potash Company
Address:	Box 5005 Sussex, N. B. E0E 1P0
Telephone: **Telex:** **Fax:**	839-2146 014-47541 839-2146, ext. 159
Contact Person:	Ivan Duke, General Manager
Established:	1980
No. of Employees:	460
Ownership:	Denison Mines Ltd., Toronto owns 60% and Potash Company of Canada (Potacan) owns 40%. Potacan is 50% owned by Enterprise Miniere at Chemique of France and 50% by Kali und Salz AG of Germany
History:	The deposit was discovered by N.B. Department of Natural Resources in 1973. International Minerals and Chemical Corp. (IMC) obtained the rights to the deposit in 1976 but assigned them to Denison in 1979. Denison assigned a 40% interest to Potacan in 1980. A mining lease was obtained in 1979 and an exploration shaft was constructed to permit underground exploration. A decision to proceed with production was announced in 1983 and production was achieved in 1985.
Raw Material:	The potash "ore" consists of a mixture of sylvite, halite, and small quantities of impurities such as clay. The depth to the ore zone varies, but is in the order of 850 m. The ore zone is irregular in shape and is subhorizontal to sloping. Thickness of the ore varies considerably with a range of 2 to 40 m. Average grade of the ore is about 29% K_2O equivalent (48% KCl).

Mining/Processing Methods: The ore is underground mined using a combination of drill and blast, and continuous mining machines in a room and pillar method. The ore is crushed and moved to surface where the potash is separated from the waste material using flotation techniques to produce a "concentrate". The concentrate is dried and compacted, then screened into various size fractions. Over 90% of the product is shipped by rail to Saint John for export by sea. The remainder is shipped by truck.

Products and Capacity: The mine has a rated annual capacity of 1.3 million tonnes of muriate of potash (780,000 K_2O equivalent).

All product from the operation has a minimum of 60 percent K_2O (i.e., over 95% purity).

Three types of product are mainly produced and are differentiated on the basis of grain size:

Standard - 14 to +65 mesh (Tyler)
Coarse - 8 to +28 mesh
Granular - 6 to +14 mesh

About 35% of the production is standard grade with the combination of coarse and granular comprising the remaining 65%.

Markets are divided into about 50% domestic and eastern United States and about 50% to offshore markets. The offshore market is diverse and sensitive to price factors such as transportation costs and availability. This offshore market is essentially global and includes countries such as India, Brazil, Bangladesh and China.

Prices for the product have stabilized somewhat in the United States with the recent ruling on potash tariffs. Prices on the global market are somewhat more variable.

Nearly all of the product is used in the agricultural sector. The company has evaluated the potential for other products such as soluble potash (chemical grade, 62% K_2O), potassium hydroxide (KOH), and potassium sulphate (K_2SO_4) but have concluded that market demand is not sufficient to warrant further evaluation at present.

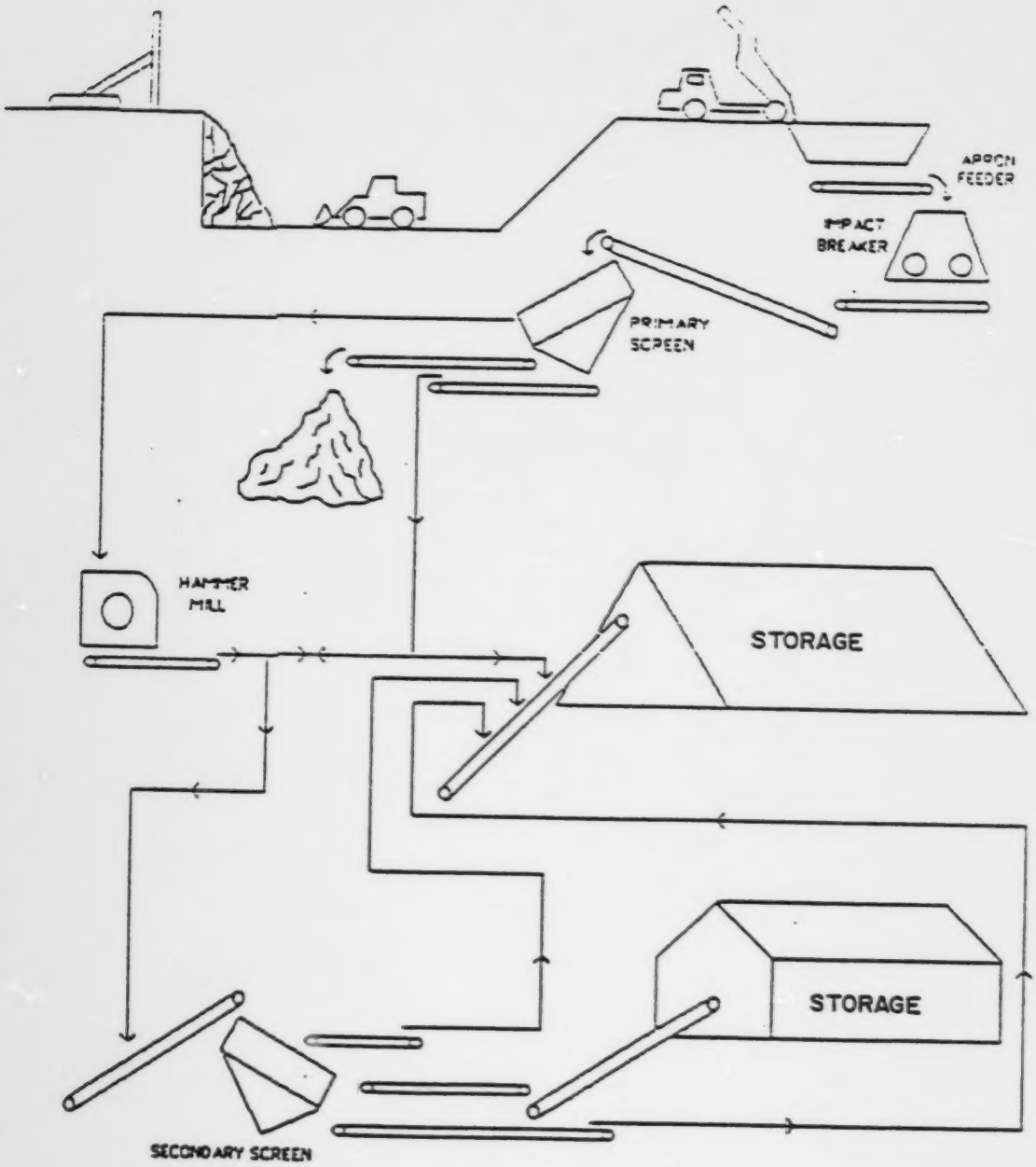
7. DUPUIS CUT STONE LTD.

Producer of: Finished Stone Products

Name:	Dupuis Cut Stone Ltd.
Address:	P.O. Box 278 Shediac, N.B. E0A 3G0
Telephone:	532-4363 532-6909
Contact Person:	Alex Dupuis
Established:	1913 Dupuis Bros. (family business) 1987 Dupuis Cut Stone Ltd.
No. of Employees:	1-10
Ownership:	Lucy Dupuis, President
History:	The company was recently established to finish stone products (sandstone, marble, granite) for building and landscaping projects.
Raw Material:	The company does not currently operate their own quarry, although potential sites are being assessed. Stone used is acquired from existing quarry operations in New Brunswick, Nova Scotia, and the United States.
Mining/Processing Methods:	An automated diamond saw (48 inch diameter) is used to cut preslabed stone. Smaller saws are used to finish the blocks to the required size. Chiseled ornamental stone is also produced.
Products and Capacity:	In response to demand.
Remarks:	The company hopes to add additional equipment in 1988-89 including a stone planer, a stone polisher, and a large diameter (96 inch) diamond saw, and plans to develop various lines of stone products.

8. ELMTREE RESOURCES LTD.

Name:	Elmtree Resources Ltd.
Address:	Box 665 Bathurst, N.B. E2A 3Z6
Telephone:	546-6382
Contact Person:	Al Buzas
Established:	1978
No. of Employees:	25
Ownership:	Elmtree Resources Ltd.
History:	A quarry has existed on a site near Petit Rocher since 1880. From 1930 to 1960, a total of about 1800 tonnes were produced by the Elmtree Limestone Cooperative Limited to supply the lime needs of local farmers. Production was intermittent between 1960 and 1978 when it was acquired by the present owners.
Raw Material:	A limestone of Silurian age is quarried adjacent to the plant. The material has a CaO content of about 53% with 3 to 4% silica.
Mining/Processing Methods:	The limestone is extracted from the quarry using drill and blast techniques and trucked about 300 m to the plant. An impact breaker is used to initially crush the rock and a primary screening is carried out using standard 5 x 12 Tyler screens (see flowsheet). The oversize material is routed to a hammer mill. A secondary screening is used to derive finer products such as agricultural lime (50% passing 100 mesh) and fertilizer filler.
Products and Capacity:	Annual production is in the 60,000 to 90,000 tonnes range depending on demand. Production capacity is



ELMTREE RESOURCES FLOWSHEET

higher but markets are a limiting factor. Existing markets are expected to remain stable.

Products include various size aggregate, fertilizer filler, flux material for the smelter at Belledune, and agricultural lime. All of the product is shipped by truck in bulk. Both dump-box tractor trailers and pneumatic tanker trucks are used for transport.

Remarks:

The company has also evaluated significant deposits of limestone at Sormany and dolomitic limestone at Armstrong Brook.

9. HAVELOCK LIME

Producer of: Agricultural Lime, Quicklime, Hydrated Lime

Name:	Havelock Lime (a division of Dickenson Mines Ltd.)
Address:	Box 59 Havelock, N.B. E0E 1W0
Telephone:	534-2311
Contact Person:	J.L. Murray, General Manager
Established:	1938
No. of Employees:	55
Ownership:	Dickenson Mines Ltd.
History:	Havelock Lime Works began quarrying in the area in 1938. The company was incorporated in 1964. In 1970, a subsidiary, Havelock Processing Ltd., was formed to manage the manufacturing of quick lime and hydrated lime. In 1983, Dickenson Mines Ltd. acquired a 60% interest in the companies and full ownership was gained in 1987.
Raw Material:	The Samphill quarry has traditionally been the source of supply for the operation but high stripping ratio for "overburden" has been encountered in recent years. A long-term arrangement is currently in place which ensures supply from a nearby quarry operated by Lafarge Canada Inc. The Samphill quarry continues to operate on a 2 to 3 month per year basis.
Mining/Processing Methods:	The operation essentially consists of two components: agricultural and industrial lime, and processed lime. A common crushing facility is used to crush and size the raw stone which is then stockpiled for use as required. In the agricultural and industrial lime operation, the crushed material is passed trough a hammer mill and screened into various size fractions

Producer of: Agricultural Lime, Quicklime, Hydrated Lime

(Figure 1). Agricultural lime is the principal product. Industrial lime applications include industrial fillers and materials for fertilizer filler, calcium granules, flue gas desulphurization, coal mine dust and methane control, and a variety of other uses.

Specifications, particularly size distributions freqently are modified to meet the user's requirements. Both bagged lime and bulk shipments can be made with bagged product comprising about 10% of the total. About 5% of the shipments are by rail with the remainder going by truck. Both conventional dump tractor trailers and pneumatic bulk tanker trucks are used.

In the quicklime and hydrated lime operation (the processing plant) the sized crushed rock is calcined in a kiln (Figure 2). A recently installed Beckenbauh annular shaft kiln, the first of its kind in North America, has a capacity of 300 tonnes per day. The existing 8 by 140 foot rotary kiln has a capacity of 200 tonnes per day and is being maintained in an operating capability. The kiln discharge is quicklime (CaO) which is sold either as a coarser pebble lime product or passed through a hammer mill to produce a finer produce (3/8" to 0). (Figure 2). A portion of the fine quicklime is hydrated by adding water. It is then pulverized, separated and stored for shipment. Shipments are mainly by truck.

Products and Capacity:

Crusher feed is in the order of 300,000 to 400,000 tonnes per year. Crushing capacity is about 250 tonnes per hour and pulverizing about 45 tonnes per hour. Calcining capacity in the new kiln is rated at 300 tonnes per day.

FIGURE 1

HAVELOCK LIME FLOWSHEET FOR AGRICULTURAL AND INDUSTRIAL LIME PLANT

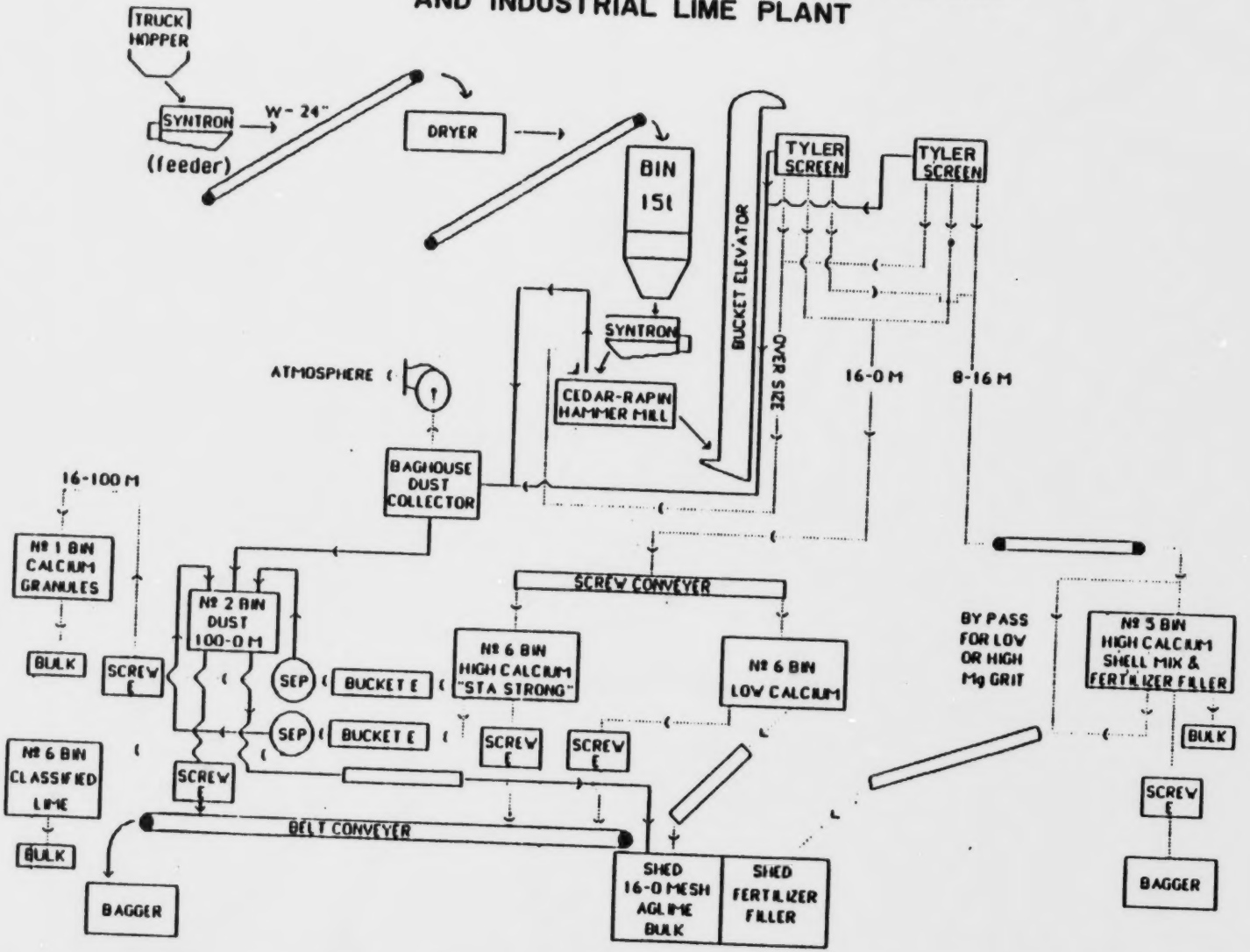
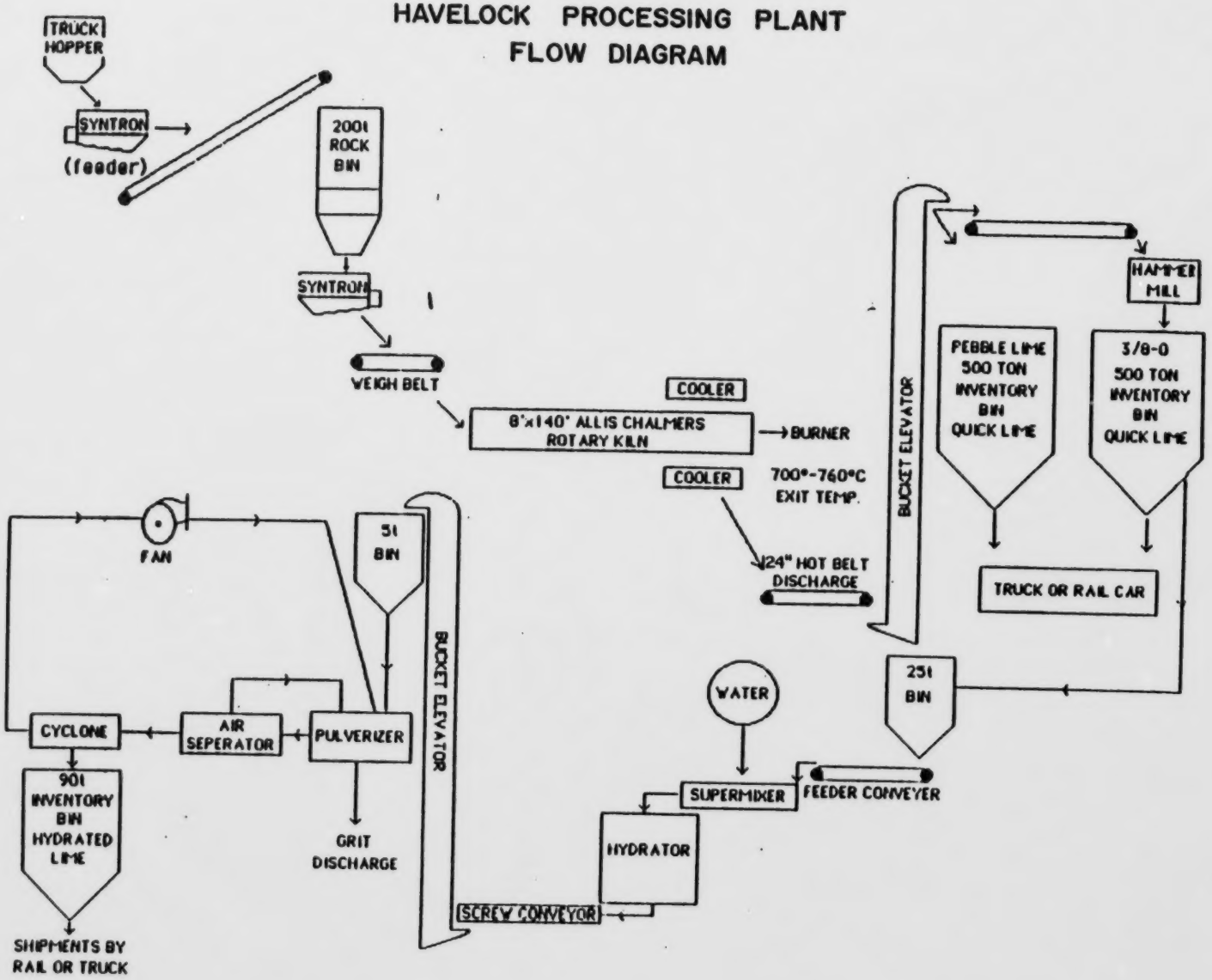


FIGURE 2
HAVELOCK PROCESSING PLANT
FLOW DIAGRAM



Producer of: Agricultural Lime, Quicklime, Hydrated Lime

The output of the processing plant is in the order of 150,000 tonnes per year. Agricultural lime accounts for about 75,000 tonnes, and industrial lime applications for about 40,000 tonnes. Sundry other products including crushed aggregate comprise the remainder of output.

About 3500 tonnes of gypsum per year are sold as a soil amendment. The gypsum is obtained from stockpiled material at the nearby Lafarge Canada Inc. operation.

10. IRVING OIL LIMITED (REFINING DIV.)

Producer of: Sulphur (Elemental)

Name:	Irving Oil Limited (Refining Div.)
Address:	P. O. Box 1260 Saint John, N. B. E2L 4H6
Telephone:	633-3000
Contact Person:	Dan Henderson
No. of Employees:	425
Raw Material:	Crude oil from various sources. Sulphur content varies with source.
Mining/Processing Methods:	Sulphur is removed from the crude oil in the refining process. A hydrogenation process is used to convert organic sulphur compounds in the crude oil to hydrogen sulphide (H_2S). The H_2S is burned under controlled conditions so that about one-third is converted to sulphur dioxide (SO_2). The remaining H_2S and the SO_2 react in the presence of a catalyst to produce sulphur and water.
Products and Capacity:	About 220 tonnes per day of elemental sulphur are produced. Selling price varies with market conditions and is in the order of $70 to $150/tonne. The principal market is to pulp mills in the Maritimes and northeastern United States.

11. LAFARGE CANADA INC.

Producer of: Limestone, (Gypsum), (Cement)

Name:	Lafarge Canada Inc. (formerly Canada Cement Lafarge Ltd.)
Address:	R.R. #1 Havelock, N.B. E0A 1W0
Telephone:	534-2301
Contact Person:	H. Kierstead (Art Hicks)
Established:	1952
No. of Employees:	6-7
Ownership:	Lafarge Canada Inc.
History:	In 1952, operations commenced at the cement plant (then known as the Canada Cement Company) and was, at that time, the only cement producer in Atlantic Canada. In 1966, a second kiln was added to increase capacity. In 1983, the kilns were closed and the production of clinker ceased but the grinding operation continued using clinker from another plant in Nova Scotia. In 1987, the grinding operation was discontinued for an indefinite period. The site presently functions as a distribution point for products from other company plants. The quarry operation continues to produce limestone to meet contract obligations for supply of unprocessed stone for lime manufacture and for aggregate applications.
Raw Material:	Limestone has been quarried from a site a short distance from the plant. Other materials such as silica sand which were required for specialty cements were purchased as required. Gypsum is quarried from a site 15 km to the east at Intervale which was first worked in 1880. In 1932-35, the Albert Manfacturing Co. produced 1179 t/annum. Canada Cement acquired

Producer of: Limestone, (Gypsum), (Cement)

the property in 1950. Production levels of 5,000 to 25,000 tonnes per year have been produced on an as-required basis but the quarry has not operated recently.

Mining/Processing Methods: The limestone for the cement plant was quarried using conventional drill and blast techniques. The stone was crushed and ground. Silica, alumina, and iron oxide were added as required depending on the type of product. The mixture was then burned in one of the two rotary kilns. The kiln discharge, known as clinker, was mixed with gypsum and ground to a fine powder to form Portland cement, and other specialty cement products.

Products and Capacity: Crushing capacity was rated at 450 tonnes per hour. Clinker capacity was 274,000 tonnes per year and grinding capacity was 330,000 tonnes per year.

Associated quarry operations have produced in excess of 400,000 tonnes per year. The quarry site is located about one kilometre east of the plant. Originally the quarry was opened to serve as a source of high calcium limestone for lime manufacture.

12. L.E. SHAW LIMITED

Producer of: Clay/Brick Shale

Name:	L. E. Shaw Limited
Address:	P. O. Box 188 Chipman, N. B. E0E 1C0
Telephone:	(506) 339-6605
Contact Person:	George Roberts, Manager
Plant Location:	Chipman, N.B.
Established:	1927
No. of Employees:	25-40 plant 1- 2 quarry
Ownership:	L. E. Shaw Ltd., Lantz, Nova Scotia
History:	The company opened a brick plant at Chipman in 1931 to use waste shale from coal mining operations in the area. A quarry was subsequently opened. Except for a brief period during the Depression of the 1930s, the plant has operated on a continuous basis.
Raw Material:	Purple-red shale, siltstone and sandstone of the Hurley Creek Formation has been extracted from a quarry 4 km from the plant since 1935. Extensive reserves are still available.
Mining/Processing Methods:	A thirty foot face is worked in the quarry. The overburden is removed and vertical holes are drilled for blasting. The material is then excavated using a large "Northwest" shovel. The "floor" of the quarry is kept above a calcareous ("limey") layer to maintain quality. Because of the variability of the layers in the quarry, some "selective mining" is undertaken for the production of certain high specification products. At the plant the material passes through various crushing, grinding, and screening circuits before being used in product manufacture.

Producer of: Clay/Brick Shale

Products and Capacity:

Capacity of the operation is rated in brick-equivalents where one brick is 57 x 90 x 190 mm. The capacity of the plant is about 14 million brick-equivalents but current production is in the 9 to 10 million brick-equivalent per year range.

The company produces a wide variety of brick, drainage and paving tile, flue liners and related products. The relative percentages of the products manufactured varies in response to market demand. A high quality "acid-resistant" brick has also been produced but there currently is a limited market for this product. This is a higher value product which has a wider market area.

Overall, markets are mainly within the Province but the company is looking into the U.S. and Ontario markets and hopes to increase their sales. Demand is currently high in Ontario due to the construction boom, but two new operations are expected to begin production there in 1988.

The products available from the Chipman operation are high quality due to a large degree to the nature of the raw material. Absorption generally is in the 2 to 4 percent range. Less than 1 percent absorption can be achieved in specialty products. For comparison, much of the "imported" brick is in the 8 to 10 percent range. Low absorption results in a limited ability for water to penetrate and cause a freeze-thaw reaction which results in deterioration of the brick. Carbon content of the raw material is also low.

Remarks:

A new product is "brick chips" for decorative landscaping. Much of the material was formerly waste. At present sales are in bulk, mainly to landscape firms.

13. NELSON MONUMENTS LTD.

Producer of: Quarried Granite, Monumental Stone, Curb Stone, Finished Stone Products

Name:	Nelson Monuments Ltd.
Address:	P.O. Box 1220 Sussex, N.B. E0E 1P0
Telephone: **Fax:**	432-9000 432-6007
Contact Person:	Merrill Nelson
Established:	1909
No. of Employees:	30
Ownership:	Nelson Monuments Ltd.
History:	The company was established in 1909 and originally operated in the Hopewell Cape area of Albert County. New facilities were established in Sussex in 1959.
Raw Material:	Granite (grey, pink and black) is quarried at several locations on an as-required basis. Imported stone is also used.
Mining/Processing Methods:	In the quarries, large blocks of stone are extracted using either a flame cutting method or drill and blast techniques. Blasting involves the use of low velocity explosives (black powder) to "crack" the block along the line of drill holes without introducing fractures into the block. The quarry blocks (25 to 40 tonnes) are cut into "slabs" of the desired thickness using a newly installed 3.5 m diameter diamond saw (replacing a wire saw). The slabs are then cut into the desired size using smaller diamond saws. Surface treatment capabilities include grinding, polishing, honing, hammered or thermal treatment, split-faced, shaped, and related techniques. Sand blasting and lettering are conducted as required. Various drilling and coring equipment are also available.

Producer of: Quarried Granite, Monumental Stone, Curb Stone, Finished Stone Products

Products and Capacity:

In the order of 20,000 cubic feet of rough stone is used annually but this amount is variable depending on demand and the type of product being produced.

The main products are:

Monumental Stone	75% of output
Curb Stone: bridges, streets, etc.	15% of output
Streetscaping: lamp posts, planters, bollards	5% of output
Stairways, Entrances:	2% of output
Other products:	3% of output

14. POTASH COMPANY OF AMERICA

(a division of Rio Algom Limited)

Producer of: Potash, Salt

Name:	Potash Company of America (A division of Rio Algom Limited)
Address:	Box 1489 Sussex, N.B. E0E 1P0
Telephone:	433-5445
Contact Person:	Donald Roberts
Established:	1973 (in N.B.)
No. of Employees:	340
Ownership:	Rio Algom Limited, Toronto
History:	The rights to explore and develop the deposit were obtained by PCA in 1973. A surface exploration (drilling) program was carried out from 1973 to 1976. In 1978, construction of an exploration shaft was undertaken and subsequent underground exploration was completed in 1980. Some salt was produced in the course of the underground development. A decision to proceed with development was made in 1980. The mine and mill became operational in 1983. The first shipments of potash through port facilities in Saint John were made in 1984. In 1986, Rio Algom Limited acquired PCA from the former owners, Ideal Basic Industries, Inc. of Denver, Colorado.
Raw Material:	The potash ore consists of a mixture of potash, salt and impurities such as clay. The ore zone varies from 2 to 30 m in thickness and is vertical to steeply dipping. Average grade is about 24% K_2O equivalent (40% KCl).
Mining/Processing Methods:	The ore is mined underground by a cut and fill method using continuous mining machines. The ore is crushed, moved to the surface and to

Producer of: Potash, Salt

the mill. The potash is separated from the waste material using flotation technology to produce a potash concentrate.

The concentrate is dried and compacted then screened into various size fractions. The majority of the product is shipped by train to Saint John for export by sea with small quantities shipped by tractortrailer truck.

High purity salt is also mined by similar techniques and is sold for de-icing salt and chemical uses. Most of the salt is shipped by truck.

Products and Capacity:

The potash operation has a rated annual capacity of 380,000 tonnes of K_2O equivalent (635,000 tonnes of muriate of potash). Increases in operational efficiency and design modifications in the mining/milling process have resulted in increased production levels in recent years.

The muriate of potash product has a minimum of 60% K_2O (i.e., over 95% purity). The product is sold in three grades as differentiated on the basis of grain size:

Standard: -14 to +65 mesh (Tyler)
Coarse: -8 to +28 mesh
Granular: -6 to +14 mesh

The potash product is shipped by rail to Saint John for export by sea. Only small quantities are sold regionally and these are shipped by tractor-trailer truck.

Market price in the U.S. has stabilized subsequent to recent potash tariff rulings. The global market has a greater price variability and is sensitive to price factors such as transportation costs and availability.

Producer of: Potash, Salt

Nearly all of the product is used by the agricultural sector. Related products such as soluable potash (chemical grade, 63% K_2O), potassium hydroxide (KOH), and potassium sulphate (K_2SO_4) also have the potential to be derived from the raw material available but market and operational considerations have resulted in a limited interest in these commodities at present.

Salt production capacity is primarily a function of market demand. Operational mining capacity is currently at a higher level than market requirements. The salt is transported by tractor-trailer truck.

All salt produced by PCA is sold by Iroquois Salt Products Ltd. under a special marketing arrangement. Iroquois is the Canadian subsidiary of the International Salt Company of New York.

In addition to potash and salt, the PCA deposit contains several other minerals including carnallite, a potassium-magnesium chloride which is a potential source of magnesium. This material occurs in zones separate from the present mining operations and has not been specifically evaluated.

15. ST. ANNE CHEMICAL COMPANY LTD.

Producer of: Chlorine, Caustic Soda (Sodium Hydroxide), Sodium Chlorate, Hydrochloric Acid

Name:	St. Anne Chemical Company Ltd.
Address:	P.O. Box 40 Nackawic, N.B. E0H 1P0
Telephone:	575-2206
Contact Person:	Jim Patterson
Established:	1978
No. of Employees:	25-29
Ownership:	St. Anne Industries Ltd.
History:	The plant was established in 1978 to produce industrial chemicals for the adjacent pulp mill.
Raw Material:	The source material for the process is high purity salt which currently is obtained from the Potash Company of America operation in Sussex. Previous to the development of the PCA mine, the salt was obtained from Nova Scotia. In the order of 25,000 tonnes per year are consumed. The salt currently used is considered to be good quality but calcium contents are above desirable levels and a treatment process is required.
Mining/Processing Methods:	The plant uses a membrane cell process patented by Asahi Chemical of Japan. In the process, an electrical direct current is applied to the cell which forces the chloride ions in the treated salt brine to dissociate from the sodium ions. The chloride ions are discharged at the anode which liberates the chlorine gas and the sodium ions migrate through the membrane into the cathode compartment. The ions associate with hydroyl from the demineralized water which liberates hydrogen gas at the cathode and produces a caustic soda solution.

Producer of: Chlorine, Caustic Soda (Sodium Hydroxide), Sodium Chlorate, Hydrochloric Acid

The production of sodium chlorate involves the application of a direct current to a brine solution which causes the sodium chloride and water ions to rearrange into sodium chlorate and hydrogen gas. The hydrogen gas is cooled to release water and is compressed and fed to a HCl synthesis unit.

Products and Capacity:

The plant produces about 9000 tonnes of chlorine per year and about 10000 tonnes of caustic soda. This material is consumed by the adjacent pulp mill along with an additional 4000 to 6000 tonnes of caustic soda brought in from the CIL operation in Becancour, Quebec.

Production capacity for sodium chlorate is 10000 tonnes per year but actual production is governed by the level of sales. A percentage of production is consumed by the adjacent pulp mill but much of the product is sold to other mills, particularly in Maine. The market is somewhat limited. The sodium chlorate is a liquid which is transported by tank truck. Hydrochloric acid production capacity is 4000 tonnes per year but actual production is variable.

16. SMITH CUT STONE AND QUARRIES LIMITED

Producer of: Red Sandstone, Olive Green Sandstone, Finished Stone Products

Name:	Smith Cut Stone and Quarries Limited
Address:	Box 69 Shediac, N.B. E0A 3G0
Telephone:	532-6902
Contact Person:	Roy E. LeBlanc, President
Established:	1818
No. of Employees:	2-15
Ownership:	Smith Cut Stone and Quarries Limited
History:	The original company was founded in 1818 and subsequently entered the stone business with the first production in 1858. The company was operated by the Smith family for several generations and was incorporated in 1968. The present owner has been with the company since 1952. Stone for numerous buildings throughout the Province and other regions, has been fabricated by this company. Examples include the museum in Saint John, the Cathedral in Moncton, and buildings at Mount Allison University.
Raw Material:	Olive green sandstone is quarried at Shediac and red sandstone from a location near Sackville on an as-required basis. Other stone is also finished at the plant.
Mining/Processing Methods:	A gang saw is used to cut the quarried block into slabs of the desired thickness. The slabs are then cut with a diamond saw to the required size and finished using planers, grinders, or polishing equipment depending on the nature of the product. Chiselled ornamental stone is also produced.
Products and Capacity:	Stone is quarried and finished on an as-required basis in response to specific contracts. Much of the work is for restoration purposes.

17. SUSSEX SILICA INC.

Producer of: Silica (Lump and Sand)

Name:	Sussex Silica Inc.
Address:	R.R. #3 Sussex, N.B. E0E 1P0
Telephone:	506-433-5890
Contact Person:	Robin Turner, Manager
Plant Location:	Cassidy Lake
Established:	1983
No. of Employees:	7-9
Ownership:	Baskatong Quartz Ltd. of Quebec and Lockhart Exploration Services Ltd. of Fredericton have interests in the company.
History:	The deposit was discovered in 1982. A pilot plant was set up in 1983 for product and market tests. Full-scale production was undertaken in 1986.
Raw Material:	Unconsolidated quartzose sand and gravel is extracted from a deposit located near Cassidy Lake, about 22 km southwest of Sussex.
Mining/Processing Methods:	The material is extracted from the pit face with a loader and passes through a field screen onto a conveyor system to the plant where it is washed and screened into various size fractions. One of the features of the plant is a hydrosizing operation which separates the plus 40 mesh and minus 40 mesh material. Product for the silicon carbide and a blast sand market is dried using an oil-fired dryer. The material is then stockpiled for bulk shipment or bagged.

Producer of: Silica (Lump and Sand)

Products and Capacity:

Current production capacity is in the order of 70 000 to 80 000 tonnes per year. Size ranges produced currently are in the 140 mesh to 1 inch plus range (about 3 inch maximum) with various screening sizes currently or potentially available as summarized below:

A. Blasting Sand

three grades:

No. 1	12- 40 mesh (US Standard Sieve)
No. 0	20- 40 mesh
No. 00	40-140 mesh

Sold in bags - mainly within New Brunswick - accounts for about 10 percent or more of total production.

B. 1/4" to 40 mesh product

Sold bulk - shipped by rail to Quebec for silicon carbide manufacture
- shipped by truck to Belledune for smelter flux
- also used in Quebec for production of silicon metal

C. Other Products

Several other products have been or could be produced as required in response to specific market requirements. These include:

- aggregate for open face precasting
- decorative aggregate (consistent white colour)
- roofing aggregate (high reflectance, low heat absorption due to white colour)
- fine silica products (silica flour)
- glass sand (high purity 99% SiO_2)

Producer of: Silica (Lump and Sand)

Remarks:

The fines from the operation are not currently used, but the material in the recycle ponds contain kaolin clay and could be evaluated further in the long term.

Since the company has been operating for only a short time, they believe that the nature of their market will vary somewhat as new products and markets are established.

18. UPPER KENT LIME WORKS LTD.

Producer of: Limestone (marl)

Name:	Upper Kent Lime Works Ltd.
Address:	R.R. #3 Bath, N.B. E0J 1E0
Telephone:	278-5359
Contact Person:	Douglas Lloyd
Established:	1973
No. of Employees:	3-4
Ownership:	Upper Kent Lime Works Ltd.
History:	The deposit has been in operation since the late 1950's and was acquired by the present owners in 1973.
Raw Material:	The marl deposit is situated at the bottom of a small partially drained lake at Maplehurst. (Marl deposits occur when calcium-rich waters flow into a lake or similar environment with suitable conditions to cause the calcium to precipitate and accumulate on the lake bottom). Original size of the deposit was in the order of 4 to 5 acres. It is estimated that a minimum of 25,000 to 30,000 tonnes remain. The deposit is up to 25 feet thick but the thickness of the deposit tapers rapidly near the shore of the lake. The deposit is reported to contain about 85 to 95% $CaCO_3$.
Mining/Processing Methods:	A drag line is used to dredge the marl from the lake bottom. The water level has been dropped lowered slightly and the marl is within about 3 feet of surface. The marl is extracted and spread on the adjacent hillside to dry and stock-piled. It is then screened to remove pebbles, twigs, etc. and trucked to local farmers for use in

Producer of: Limestone (marl)

potato fields. The main operating period is late April to June. An additional 2 to 3 week period of operation typically occurs in the fall to stockpile material.

Products and Capacity: Annual sales are in the order of 2,000 to 2,500 tonnes.